is not on record where these personages joined company before they set out *westwards* for Jerusalem.

As comets long afterwards were supposed to presage disaster, so the star may have been regarded as an indication of the approaching death of King Herod. This would start the question as to his successor, whom the "wise men" would desire to stand well with, or to "worship." With what happened at Jerusalem we have nothing to do. On approaching Bethlehem about noon, they again recognized the star over the town, as Venus would be at that time, on the supposition that the "star in the East" which they had first seen was really that planet.

Another point connected with this matter relates to the question of new stars. Supposing there were a new star in the east, why should the population be affrighted? The records of astronomy, as we have seen, tell of a considerable number of such stars, and during the last few years we have been favoured with our fair share of such appearances, and yet the world is none the worse for them. The view which has recently been put forward, with an amount of evidence to back it which almost puts it beyond question, is that in new stars we see only such phenomena as we must expect; we see the result of no unnatural dealings with the regulated order of the universe, but simply the collisions of swarms of meteorites, these meteorites being not only not in our own system, but lost, it may be, in the very depths of space. Why should such a thing as this affright us? It is simply what happens at a level crossing when a train runs into a cart, and it does not seem likely that such an ordinary piece of mechanism as this would be chosen as a means of frightening or ringing the death-knell of a world.

Modern science, while thus abolishing mystery from the skies, is only enhancing the majesty of all created things. The universal law and order are more clearly seen in every great advance; and yet, with a population so superstitious that the least uncomprehended thing affrights them, our statesmen are still on the side of ignorance, and hinder rather than aid the introduction of science into our schools.

THE MICROSCOPE.

The Microscope in Theory and Practice. Translated from the German of Prof. Carl Naegeli and Prof. S. Schwendener. (London: Swan Sonnenschein and Co., 1887.)

THIS book opens to English readers an entirely new page in microscopical literature. It leads the way in supplying a want which every thorough microscopist has realized for the last twenty years. In a complete form this treatise has been accessible to the German reader for at least ten years. The absence of it, or an equivalent, in the English language has been a most serious drawback to the advancement of the highest optical work in English microscopes. In optical manipulation, the English optician at his best proves not only equal to any in the world, but, in the highest class of work, has shown lately that he takes a foremost place. But with no attempt on the part of English mathematicians and microscopists to become masters and expounders of the theory of the microscope and of microscopic vision, the practical optician can make no real advance. English "stands," and those made in America on English models, are of exquisite construction, and are quite equal to our present necessities; but, for all the great advances and improvements that have been made in *English* object-glasses during the last fifteen years, we are, for all practical purposes, primarily indebted to Germany. And this is readily explained by the fact that the German specialists have made a systematic and persistent study of the theory of the microscope.

It is not forgotten that it was to the suggestion of Mr. J. W. Stephenson that we are indebted for the invaluable improvements that belong to the homogeneous system of lenses.[1] But, without doubt, it was on account of the insight which a study of the theory of microscopic vision brought with it, that Mr. Stephenson perceived at once the advantages of great numerical aperture, and the new way to obtain it. Moreover, it is certain that Prof. Abbe was approaching this very method of employing lenses, though from another point, and not in so direct a way. It would have been shortly reached by him there can be but little question; but when it was reached, what did a constant, enthusiastic, and laborious study of the theory of the microscope carry with it? A perception, that with glass of greater range of refractive and dispersive indices than any we possessed, we might not only secure great numerical apertures, but secure them devoid of all colour; that we could not only annul the primary, but also the secondary and tertiary, spectra. It need not surprise us then, that, in a country where such splendid theoretical and mathematical work had been done by experts on the principles of microscopic lenses and the laws of their construction and use, even the Government should be convinced that the time to aid the optical expert had come; that theory had demonstrated the practical possibility of a great improvement in the construction of lenses. The sum of £6000 was granted by the German Government to Abbe and his collaborateurs, and with, as we have reason to believe, an equivalent outlay on Abbe's own part, the new glass was prepared; and the new Apochromatic lenses with their systems of compensating eye-pieces devised.

It is in no spirit of boast, but rather in a spirit of humiliation and regret, that we say that we have examined many of these apochromatic objectives of all the powers made in Germany, and we have examined all the principal ones that have, since the new glass has reached London, been made there; and we are bound to say that the English work, based on the principles laid down by Abbe, is so fine as to make the regret immeasurably keener that English microscopical literature has been for all these years a blank, for practical purposes, on the theory and principles of optical construction, and on the theory of microscopical observation and interpretation. Such a paper as that of Prof. G. G. Stokes, P.R.S., on the question of a theoretical limit to the apertures of microscopic objectives (Journ. R.M.S., vol. i. p. 139) from its very loneliness only gives emphasis and point to our contention. Those who have any doubt of the full force of what we are here contending for, have only to compare a dry $\frac{1}{6}$-inch objective, say of twenty-five years ago, made by the best makers in London, with a well-chosen water-immersion of ten years ago; and both these with a recent homogeneous glass of the same power with a numerical aperture of 1·5. Or still better, a dry $\frac{1}{50}$-inch objective, of the same date and the same makers, of numerical aperture 0·98, with a water-immersion lens of the same power of say ten years ago, having an aperture of 1·04, and a recent homogeneous $\frac{1}{50}$-inch, with a numerical aperture of 1·38. Still more strikingly, let the same observations be made with a dry $\frac{1}{12}$-inch objective of twenty years ago, with a numerical aperture of 0·99, and a homogeneous lens of the same power, with numerical aperture 1·5; and, finally, both these with an apochromatic objective of the same power by the same London makers and an aperture of 1·40. We venture to say, to histologist, bacteriologist, diatomist, and all other serious workers with the microscope, that there can be no proper comparison of the results; or, rather, the comparison is odious indeed for the oldest, and even the elder, lenses.

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[1] "On a Large-angled Immersion Objective, without Adjustment Collar with some Observations on Numerical Aperture," by J. W. Stephenson F.R.A.S. (Journ. Roy. Micros. Soc. vol. i. p. 51).

But, as we have stated, it is to Germany we are indebted for the *knowledge* out of which, alone, these improvements could have arisen. In spite of the length and abundance of English treatises on the microscope, it has never been part of the scope of the respective authors to do other than make the scantiest reference to the principles of the microscope; and nothing is found that will elucidate the theory of the construction of objectives, and eye-pieces, and the possible and real relations of each to the other. There is nothing to be found indeed in our language, except in the invaluable translations published in the successive Journals of the Royal Microscopical Society, which discusses the phenomena of diffraction, of polarization, of the principles of the true interpretation of microscopical images, and the theory of work with the microscope. English workers with high powers have discovered painfully where their lenses during many years were at fault; they could show our opticians *what* they wanted; but it has been only as the result of the laborious mastery of the theory of lens-construction by German investigators, with Abbe at their head, that the English worker has been able to get his wants, in object-glasses and eye-pieces, supplied.

But like all advances in insight and analytical power, these very improvements, so welcome and so helpful to searchers in many important branches of science, only open up the horizon of the unknown more fully; and the very knowledge we get, through the inestimable improvements, only reveals new difficulties; and again creates optical wants. It is, then, with pleasure indeed that we hail this excellent translation of Naegeli's work on the theory and practice of the microscope The book has long been announced, and many have looked, year after year, eagerly for its coming. But a series of untoward circumstances have combined to make the delay inevitable. The translation was begun some ten years since by Mr. Frank Crisp, the Secretary of the Royal Microscopical Society, purely in the interests of microscopy in England. He wished to fill the blank in the microscopical literature of the country, which had, in fact, become almost a dishonour to us. This book of Naegeli and Schwendener is a thorough treatise on the theory of the microscope, giving a detailed theoretical exposition of the construction of objectives, eye-pieces, &c., with analytical determination of the path of the rays in refracting systems; discussing exhaustively chromatic and spherical aberration; the influence of the cover-glass; the flatness of the field of view; the centering of systems of lenses; the importance of aperture, with a discussion of the diffractional action of the aperture of the lenses; and the question of illumination.

With equal care and thoroughness there is a discussion of the testing of the microscope, in all its branches, which cannot but make the student conversant with every essential point in the construction of the instrument; and an absolutely invaluable monograph on the theory of microscopic observation, which no one attempting to publish results of any importance dare leave unread or even unstudied. The phenomena of polarization receive equal care in treatment and must prove of the utmost value.

To put such a book within the reach of English readers, Mr. Crisp rightly felt, would be to give the needed stimulus to English microscopical observation: it would put them on the same horizon with German specialists. But the first impediment to its appearing in print was, that Mr. Crisp was compelled, by the weight of other claims upon his time, to relinquish the task of preparing the translation for the press when only eighty pages were in type; and a large lapse of time ensued before the labour was at length resumed by Mr. John Mayall, Jun., one of the editors of the Journal of the Royal Microscopical Society. But, beyond this, when Mr. Mayall had done his work and the printing of the work was complete, a fire destroyed the premises of the printer and all but a small portion of the type was wholly lost. The present issue is therefore an entire reprint.

There is but one point that we can see in the book, as it now stands, that need call for the slightest reflection: it is that the authors adopt, and discuss at considerable length, a method of testing the resolving power of objectives which has had—in another connection—the honour of a mathematical refutation by the highest living authority on microscopical optics, Prof. E. Abbe, of Jena. This method consists of viewing, with the objective to be tested, what were assumed to be "miniatured images" of a network of wire gauze produced by minute globules of oil and other matters, which images were supposed to be reduced to the "limit of discrimination" by simply distancing the wire gauze from the oil globule. Prof. Abbe's demonstration (*vide* Journ. Royal Micros. Soc. 1882, pp. 693-96) of the fallacy of this method proves that the combination of a microscope with a minute oil globule, or its equivalent, for viewing a distant object—whether wire gauze, or a so-called "double star" arrangement as advocated by Dr. Royston Piggott—serves no purpose whatever in determining the limit of the resolving power of the objective; but merely produces a very low-power telescope; the power of which may easily be so low, indeed, that the eye fails to differentiate, or even to perceive, the image!

The adoption of this fallacious mode of reasoning, however, amounts only to a blemish in an otherwise most excellent work; and with the publication and accessibility of Abbe's correction can do but little harm.

It would have given a still higher value to the book if the chapters devoted to an exposition of Prof. Abbe's views on the formation of images in the microscope had received the advantage of his personal and later revision; but it is none the less due to the authors to acknowledge the credit that is justly theirs, for the very early recognition of the value of his investigations; and for the earnest manner in which they endeavoured to embody those investigations in a popular text-book at a date (1877) when hardly more than the barest outlines of the subject had been published by Prof. Abbe himself.

We note that the authors give the preference to daylight over lamp-light, believing that it exerts less strain upon the eye. We suspect that the majority of English observers, especially at continuous work, and with high powers, will be inclined to reverse this judgment. Extremely white and intense light can be obtained from good modern lamps, and, unlike daylight, it is unvarying, devoid of caprice, and easy of manipulation. But this is a matter, perhaps, in some sense subjective, and not of vital moment.

The world of science generally and of microscopical science in particular, is deeply indebted to Mr. Crisp for initiating this translation, which, we have taken pains to find, is most carefully done; and to Mr. Mayall for his part of the laborious undertaking. We can only hope, in the interests of English and American science, that it will find a large circle of careful readers on both sides of the Atlantic; and we warmly concur in the hope expressed in the preface, "that the volume may be supplemented before long by an English version of the further researches in microscopical optics by Prof. Abbe, of Jena, which have extended so much our knowledge of the matters dealt with in Naegeli and Schwendener's work."

W. H. DALLINGER.

THE CRUISE OF THE "DIJUMPHNA."

The Cruise of the "Dijumphna." With Reports of the Zoological and Botanical Results of the Voyage. By R. Bergh, J. Deichmann Brandt, J. Collin, H. Hansen, T. Holm, C. Jensen, G. Levinsen, C. Lütken, L. K. Rosenvinge, M. Traustedt, and N. Wille. (Copenhagen, 1887.)

THE Danish Arctic Expedition of 1882-83 owes its initiative to its able commander, Lieut. Hovgaard, of the Danish Navy. This enterprising officer, whose practical experience of Arctic navigation gave great weight to his opinions on the subject, had early in 1882 published a pamphlet, entitled "Suggestions for a Danish Polar Expedition," in which he advocated his own theories regarding the distribution of land and water in the Arctic regions, and the feasibility of finding some hitherto untried route for circumpolar exploration.

In response to his appeal for means to test the accuracy of his opinions, a private individual, Herr Gamél, of Copenhagen, placed at his disposal a screw-steamer, since known as the *Dijumphna*, whose equipment for Polar explorations and scientific observations was supplemented at the expense of the Danish Ministry of Marine.

Thus well prepared, the Expedition left the Copenhagen Roads, July 18, 1882, but unfortunately the *Dijumphna* early encountered ice, which was found to be so dense south of Cape Tschernui Noss that it was only after a delay of more than four weeks off the south-west coasts of Nova Zembla, that an entrance could be made into the Sea of Kara, where, in accordance with Hovgaard's anticipations, the water was clear. The hopes of success to which this fact gave rise proved, however, delusive, for the ice began to re-form so rapidly that, within a few days of their passage into the Kara Sea, it had become apparent that the *Dijumphna* was fast bound for the coming winter; and it was only after nearly a twelvemonth's detention that the ice began to loosen, when the westerly trend of the drifts carried the ship, in the August of 1883, back towards the entrance of the Sea of Kara. With a broken screw and failing supplies, there was no alternative but to renounce all hope of advancing further east, and, accordingly, by help of sails the *Dijumphna* began its homeward voyage, which was so retarded by ice-drifts and storms that the harbour of Copenhagen was not reached till December 3, 1883.

In the course of the winter the sun remained below the horizon from November 20 to January 22, the temperature at the latter date falling as low as − 47°·9 C.; while there was constant danger of being crushed in the ice, or carried with moving drifts on the shore. Yet, notwithstanding these drawbacks, the trawl and dredge were diligently used at 190 different stations, ten of which were in the Jugor Schar and in Olenje Sound, off the south-west coast of Nova Zembla. Most of the deep-sea soundings were carried on in the Sea of Kara, between 69° 42′ N. lat., 64° 45′ E. long., and 71° 46′ N. lat., 65° 14′ E. long., within which limits the ship was moved forward and backward by the ice-drifts. This ground proved specially rich, and Herr Holm, the efficient naturalist of the Expedition, was able to bring home an exceptionally large number of well-preserved botanical and animal collections, which now form a valuable addition to the contents of the Danish National Museum, to which they have been generously ceded by Herr Gamél, the owner of the *Dijumphna*.

Herr Holm's report of the flora of Nova Zembla, which he examined at twelve distinct localities during the *Dijumphna's* long detention off the coast, confirms the statement of Von Baer as to the abundance of vegetation on the tundras, but he differs from him in regard to the mode in which plants found their way into these high latitudes. According to Von Baer, to whose report of his scientific mission, undertaken for the Russian Government in 1837, we are indebted for our first acquaintance with the Nova Zembla flora, its plants have all been stranded from neighbouring shores through the agency of drifting ice. Herr Holm, on the other hand, believes that a few forms may be survivals from pre-glacial periods, but that the presence of the majority is due partly to the agency of birds, of which large numbers, more especially Tringa and other waders, frequent the shores, and partly to the winds, and to ice-drifts. Insects are too rare to affect the question of plant-propagation, and his observations—that most plants on the tundras have the corolla directed upwards, while pendent or drooping forms are very rare, and that the majority are scentless, and of one uniform colour—appear to favour these views; although it is possible that the existing flora may also to some extent be due to self-fertilization.